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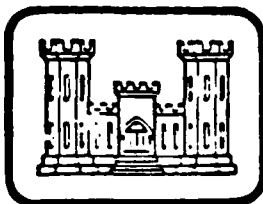
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COAL HANDLING

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1.0 PURPOSE

The purpose of this report is to give a general overview of one stage of the process of using coal as a primary energy source. This report will cover many aspects of coal handling and storage. Since the size and type of equipment used in coal handling is based on the type of coal used and the power plant requirements, this report will be written in generalities and not specifics.

2.0 SUMMARY

The problems involved in handling and storing coal outside and inside the plant of the consumer have increased, and one might say, almost in proportion to the increase in the size of boilers. At a small power plant, it may be necessary to handle only 30 tons of coal a day, while many of the larger plants use over 3000 tons a day. Intensive efforts have been applied, with fair success to the development of efficient methods for handling and storing a wide range of tonnage. However, while these methods will vary to suit the size of the plant, many of the operations are similar whether the plant is small or large.

This report will familiarize the reader on coal handling systems and equipment and will give the reader a general view on how the equipment is used.

3.0 COAL SELECTION

After the decision has been made to use coal, an analysis should be made on the type of coal to be used. Every design decision made before the analysis may prove to be a limitation in buying coal for the plant. Purpose of a fuel analysis is threefold: (1) To find out what fuels are available to the plant, especially what grades of coal; (2) To establish the relative value of these fuels; and (3) To attempt to predict, or at least allow for, changes in relative value in future years. Unless an individual was qualified to make the analysis, it would pay to bring in a professional fuel consultant at this time to perform this analysis.

4.0 TRANSPORTATION

The three most common ways to ship coal to steam generating plants are by rail, barge, and truck. Since barge shipments are limited to certain areas and truck shipments are not feasible unless the coal mine is located near the power plant, rail shipments are the most used means for coal transportation to the steam plant.

In transportation by rail, the three basic ways to ship coal are by bulk rate, and in unit and integral trains. The bulk rate train is a shipment of coal from one or more origins with a definite minimum tonnage that qualifies for the special bulk rate. A unit train moves from one origin to one destination.

with the possibility of other trips to different destinations to better utilize the equipment. The integral train travels from one origin to one destination and returns.

Total coal usage and time scheduling will play a large part in the decision on means of transportation. With a small usage of coal, the bulk-rate train may be the most feasible route.

Unit trains seem to be more common with industrial plants consuming at least 150,000 tons/yr of coal. The integral train is mostly used by electric utilities with a large coal usage requirement. Other factors to be considered in selecting a mode of transportation are train capacity, distance between mine and plant, car type and capacity, loading and unloading facilities and storage.

One other means of transportation used in the coal industry is overland conveyors. Overland conveyors are used in many cases where the mine site is located relatively close to the steam plant.

5.0 UNLOADING COAL

Unloading the incoming coal is the first step of the handling process at the plant site. The type of unloading facility is very much dependent of the mode of transportation. In other words, unloading a train is very different from unloading a truck or barge.

5.1 UNLOADING BY RAIL

Rail cars will usually be of three basic designs: (1) The conventional, manually locked door, saw-tooth, bottom dump hopper; (2) A bottom dump type, where virtually the entire coal supporting area is opened for quick unloading; and (3) A top dump car.

5.1.1 UNDERTRACK HOPPER

The undertrack hopper is basically used for single car bottom dump unloading. The saw-tooth and bottom dump type cars can be unloaded in an undertrack hopper. A remotely operated 100-ton bottom dump car can be unloaded in 20 seconds. The manual saw-tooth cars are used mainly when you would unload 10 cars or less each week.

5.1.2 TRESTLE-DUMP SYSTEM

In this system, the cars are emptied from a railroad trestle onto a long triangular pile below. Depending on the pile height, this pile may also be used as an active storage pile. This type of unloading system can be designed to unload several cars at the same time if rapid unloading is required.

5.1.3 ROTARY CAR DUMP

This type of car unloading is required for top dump cars. Rotary car dumps are simple in the fact that they are fully automatic, therefore, no skilled labor is required. Rotary car dumpers can handle as many as 35 cars/hr. This system is used when handling a minimum of 500 tons/day.

5.2 UNLOADING BY TRUCK

Trucks are unloaded directly into a basement hopper or bin, or onto an outdoor storage pile. A bottom dump truck is used when limited to dumping in a hopper or bin. The hydraulic bed type dump truck can be used in either type of unloading.

5.3 UNLOADING BY BARGE

Barge unloading is usually done by one of three basic ways: (1) Bucket elevators, (2) Bridge-type unloader with rail mounted clamshell buckets; or (3) A crane or tower housed trolley boom with a clamshell bucket.

5.4 ADDITIONAL EQUIPMENT REQUIREMENTS FOR COAL UNLOADING

The physical properties of coal, plus weather conditions, often necessitate additional support equipment to the unloading process. Below is a list and description of equipment that may be required in coal unloading systems.

a. Shakers or Vibrators - This equipment is used in conjunction with rail unloading to insure the complete discharge of coal from the car. This is especially helpful when unloading wet or partially frozen coal.

b. Thawing Equipment - Heating equipment is often used to thaw out frozen coal from rail cars. This equipment may be in the shape of either portable or fixed type radiant heater using either electric or gas. (NOTE: Radiant heaters are used to avoid explosions and fires). Another type thawing system is the thawing shed. This is just a heated building where the train can run through with heaters installed along side and between the train rails.

c. Dust Suppression Equipment - This system may be required to minimize suspended dust particles in the atmosphere. State and Federal regulations are usually involved in the Dust Suppression Requirement. For more information on Dust Suppression, see paragraph 11.3.

d. Weighing Devices - If the coal is to be measured on the receiving end, weighing devices may be used in conjunction with the rail and truck shipments. Rail or truck scales are used before the coal is dumped.

5.5 COAL UNLOADING OVERVIEW

No matter what system is used, unloading should be done in an expedient manner to avoid any unnecessary labor and mostly to avoid any costly demurrage charges on the transportation equipment. Once the coal has been received, the remaining portion of the handling system is independent of the mode of transportation.

6.0 FEEDERS

A feeder is a device that delivers coal at a controlled rate, from a storage area to a conveyor. The feeder distributes the coal uniformly to reduce power cost and equipment wear and to insure that the coal load does not exceed the belt capacity.

6.1 APRON FEEDER

This feeder is made of heavy steel pans mounted on double rolls of steel rolling chain. The pans carry the coal along at low speeds, and skirts or side plates permit the coal to be carried at considerable depths without spilling over.

6.2 BELT FEEDERS

Belt feeders are nothing other than short belt conveyors with closely spaced idlers for support against the impact of the coal.

6.3 BAR-FLIGHT FEEDER

Where pit depth must be held to a minimum, the bar-flight feeder works well. This feeder consists of bars or flights attached to two strands of chain in a manner that permits the bars to slide along the flat bottom of a trough, dragging the coal.

6.4 VIBRATING FEEDER

The use of the vibrating feeder is very common because of its low power demand and because most of its parts are not subject to friction wear. Some type of electric oscillator is used to vibrate arms or bars attached to a feeder pan. The coal flows in a smooth stream, and by varying the intensity of the vibration, the feed rate can be regulated.

6.5 OTHER FEEDERS

Other types of feeders used are rotary plow feeders, reciprocating feeders and screw conveyors.

7.0 COAL STORAGE

Coal storage is usually the next step in the handling process after its arrival in the yard. Storage of coal can be divided into two categories according to purpose. Live or active storage supplies the firing equipment directly, while dead or inactive storage is kept as a reserve against delays in shipment. Usually, live storage is under cover and dead storage is outdoors. Live storage is kept under cover to keep the coal slated for immediate use from freezing and other effects of the weather.

7.1 OUTDOOR STORAGE

Where outdoor storage serves only as a reserve, normal practice is to take part of an incoming shipment and transfer it directly to live storage within the plant, and to divert the remainder to the outdoor pile. Coal is reclaimed as needed and routed to the plant. How much transfer there is between outdoor and indoor storage, and how often stockpile coal is reclaimed, depends on the coal's storing qualities, the size of the pile in relation to plant use, etc.

Before you build an outdoor pile, there are several things to know about the behavior of coal. First, and most important, is that all coals tend to combine to some extent with the oxygen in the air. Usually, this is an extremely slow process called weathering. It causes some loss of heating value - less than 1% the first year of storage for most coals, but up to 2% for low-rank coals - and can change firing characteristics. Weathering also tends to make the majority of coals slack - that is, it promotes a reduction in size or crumbling. Slacking is highest near storage-pile surfaces, and is greatest for low-rank coals.

If conditions are such that oxidation of coal proceeds at a rapid rate, enough heat can be generated to cause spontaneous combustion. There are two basic ways to prevent this phenomenon: (1) Make sure that air moves through the pile fast enough and uniformly enough to carry away heat without causing an appreciable temperature rise; or (2) Reduce air flow through the pile to a minimum to reduce the probability of a reaction.

What might be called the free air flow method is the simplest, but it is limited in application to piles of sized coal. Reason: Double-screened coal leaves relatively uniform air passages in a pile. In small, stoker-fired plants, this works well but larger plants rarely buy sized coals, and if fines are present in the unsized shipments, it is necessary to use the second method: Cut air flow to a minimum.

The problem is that, if fines exist along with coarse lumps, segregation results - that is, when coal is dumped on a pile, the fines tend to stay in the center and the coarse lumps roll to the outside. Such segregation produces areas or lanes where air flows readily, and others where it hardly flows at all. Somewhere in such a pile, there probably will be just the right combination of air flow and heating to produce spontaneous combustion.

The best defense against segregation is layer-piling. When you store bituminous coals, build up your pile in layers of from 1 to 2 ft thick, and thoroughly pack each layer (to a density of from 65 to 72 lb/cu ft) to eliminate air spaces. Form the top of the pile in a slightly crowned fashion, and make it symmetrical to permit runoff of water. Cover sides and top with 1 ft of compacted fines, and cap with a 1 ft layer of sized lump coal.

Stockpile subbituminous coal and lignite in the same manner, but make the layers thinner - not more than 1 ft thick. It is not practical to seal these piles with coarse coal, since it will weather and slack to small size in a short time. However, be sure to cover the top and sides with slack size coal before compaction. In addition, place snow fences across the pile, normal to the direction of prevailing winds. This helps prevent the drifting of fines, which can cause spontaneous combustion.

A properly built and sealed pile should present no problem, but it must not be forgotten. For large piles, make a visual hot spot inspection daily; and do it at least weekly for smaller piles.

Heated areas can be spotted in wet weather by rapid drying and a lighter color of the surface coal. On a cold or humid day, streams of vapor and the odor of gas are signs of heating or of air entering the pile. Hot spots also can be located by probing the pile with a steel rod. If the section of rod withdrawn from the pile is too hot to handle by hand, then you have a problem.

7.1.1 STACKING CONVEYORS

Stacking conveyors of different types are used to build storage piles. The bucket wheel stacker/reclaimer is frequently found in both industrial and utility plants, because of its ability to perform both stackout and reclaim operations. This stacker/reclaimer is used to build long triangular piles, operating from a conveyor running parallel to the pile. Both vertical and horizontal-position adjustments are usually provided, so the stacker may build onto the pile as close to the top as possible. When the pile height reaches a maximum at one end, the stacker moves a few feet along the pile. Reclaiming is done by reversing the direction of the wheel and conveyor.

The radial arm stacker/reclaimer is similar in operation to the bucket wheel, the difference being the configuration of the wheel.

7.1.2 LOWERING WELLS

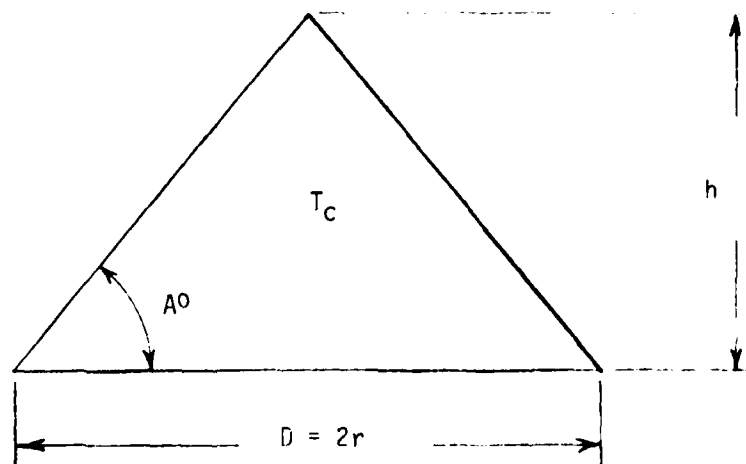
A conveyor brings the coal to the top of the lowering well. As the coal falls inside the well, the coal opens gravity-operated doors at the proper elevation and stacks the coal in a conical shape pile.

7.1.2 TELESCOPING CHUTES

Telescoping chutes are also fed by a conveyor. The chute has several sections that can be raised or lowered to minimize the free-fall height of the coal. This stacker has an advantage over the lowering well in that it operates without contacting the pile. This makes cleanup and reclaim operations easier.

7.1.3 STORAGE PILE CALCULATION

The following is the formula for determining the capacity of a storage pile:



Conical Pile
Capacity = T_c in Tons

$$T_c = 0.02618 r^3 \tan A$$

Where

$$\frac{A}{35^\circ} - 0.01833 r^3$$

r - Radius of Base Cone
Tc - Tons of coal in conical pile

$$40^\circ - 0.02197 r^3$$

h - Height of pile

$$45^\circ - 0.02618 r^3$$

Coal - 40 cub ft per ton @50 lbs per cub ft

$$50^\circ - 0.03120 r^3$$

A - Angle of repose

$$55^\circ - 0.03739 r^3$$

$$60^\circ - 0.04535 r^3$$

Example Calculations:

100 ft Diameter Pile

35° Angle of Repose

$$T_c = 0.01833 (50)^3$$

$$= 2291 \text{ Tons}$$

7.2 COVERED STORAGE

The amount of storage capacity required dictates the type of structure. For small plants a simple bin might be enough. Larger capacities require the use of in-plant tanks, silos, and bunkers designed to conserve floor space and permit convenient flow to firing equipment. Still larger capacities necessitate the construction of huge silos, tanks and bins outside the power plant.

Storage bins are used to store some quantities of coal. Bins are mostly cylindrical with conical shaped hoppers. It is important to make the slope of the cones surface greater than 70 degrees. This will insure 100% live storage in the bin.

Concrete silos, some 200 ft or higher, are becoming increasingly popular for storage, especially of western coals, which have greater amounts of fines. The totally enclosed silo protects the coal against the effects of weathering and eliminates fugitive-dust problems. The silo can be designed for 100% live storage if desired.

A storage shed is another type of covered storage available. This is nothing other than a roof extended over the coal pile with open sides for ventilation. The storage shed does not eliminate freezing but does limit the amount of weathering.

Coal bunkers usually are suspended from beams and girders high above the firing floor of the steam plant. The two basic designs are parabolic and cylindrical in cross section.

8.0 CRUSHING

Crushing is defined as "the breakdown of particles into fragments with a top size greater than 1/20 of an inch (about 14 mesh)." These particles may range from the largest lumps found in as-mined coal to smaller sizes fed to the crushing machine from a primary breaker.

Crushing is required when handling unsized coal, and may be done near the receiving area before the coal is stored, or in the plant before it is used. Most coal for stoker-fired plants is bought in the required size, so crushing is not necessary unless it becomes economically advantageous to buy run-of-mine or large lump coal. Pulverized coal-fired units usually have a top-size specification larger than can be handled by the pulverizer, and crushers are necessary. Run-of-mine coal is also often bought for these units.

In most industrial plants, unsized or oversized coal is crushed just before it is moved into a covered storage area. Coal that is stored outdoors is normally crushed after it is reclaimed from the pile and before it is placed in the boiler silos or bins. Several types of crushers are found in steam plants: Rotary breakers, single and double roll crushers, and hammermills.

8.1 SINGLE-ROLL CRUSHERS

These crushers are usually used for reducing run-of-mine coal to a maximum size of 1 1/4 to 8 in. The single roll crushers have a toothed roll, which crushes coal against a breaker plate. One disadvantage for some applications is that the abrasive action between the coal and plate produces a relatively large quantity of fines. Product fineness is adjusted by shifting the breaker-plate position with respect to the roll.

In some units, relief springs on adjustable breaker plate rods protect the roll from damage by debris. The plate swings away from the roll when particles harder than coal are caught between the two. Others protect the crusher with a shear pin on the driving pulley. This breaks when hard materials hamper roll rotation.

8.2 DOUBLE ROLL CRUSHERS

The double rolled crusher uses the impact of specially shaped teeth on both rolls to accomplish most size reduction. Compression action is secondary,

thus minimizing fines. Through various means, size adjustments, sometimes up to 11 inches, may be made during operation. One popular design compounds two double-roll crushers, a primary atop a secondary crusher, into one unit. It is operable as a two stage crusher or as two separate crushers and may be adjusted to produce any desired coal size. One important thing to remember about the double-roll crusher is that the machine capacity varies dramatically with desired size. For example, from a 5 inch lump feed a unit could deliver 90 Tph of 3/4 inch product or 150 Tph of 1 1/4 inch.

8.3 HAMMER-MILL AND RING CRUSHERS

These crushers accept mine run feed from 28 inch lump size downward. Both types use centrifugal force to deliver heavy blows to the feed while it is in suspension, driving it against a breaker plate until it is reduced to a size small enough to pass through the discharge. Grate bars may be included in the discharge opening to fix the maximum size. A varied hammer mill design that operates in either direction is reversible to equalize wear on its components. The acknowledged high capacity, versatility and toughness of hammermill and ring crushers must be balanced against their production of greater fines than most other types, and the need for thorough maintenance and prompt replacement of parts subject to sullyng and wear. Their most popular use may be in crushing refuse to transportable sizes.

8.4 ROTARY BREAKER

Breakers are generally designed to reduce large lumps of as-mined coal to manageable size for further processing.

The rotary breaker employs a slowly revolving cylinder having a perforated plate for the passage of coal and a discharge chute for refuse. Lifters on the side raise the coal and let it fall to the bottom using gravity as the breaking force. Coarse refuse and tramp iron are discharged to a refuse chute. Undersized coal is scalped off before it enters the breaker.

8.5 SELECTING TYPE OF CRUSHER

Unless one has considerable experience in crusher selection, it generally is best to submit specifications to the manufacturer and allow him to recommend the best unit for your plant. Here is some of the data you should provide: (1) Type of coal burned, its source and condition (wet, dry or frozen); (2) Hard grove grindability; (3) Type of crusher feeder; (4) Feed size to crusher; (5) Product size; (6) Allowable percentage of fines; and (7) Crusher throughput.

9.0 SAMPLING

A continuous flow of reliable data as to the physical and chemical characteristics of the coal being produced is required by producers and users alike. The essential data must be obtained by analyses made of samples which are fairly representative of the coal.

Samples are generally gathered at intervals from the product stream by automatic mechanical samplers that are designed and built to yield proper test data consistent with ASTM sampling principles. To obtain completely representative samples, increments must be withdrawn from the full cross section of a flowing stream of coal. The mechanical sample cutter should accept with ease the full range of coal sizes to be found in the stream. Experience has shown that the cutter width should be from two and a half to three times the diameter of the largest possible piece, and its design and velocity of movement should be calculated to create a minimal disturbance within the stream.

To maintain a given accuracy, the number of increments, or the quantity of material obtained by a single cut of the automatic sampler, should be increased in proportion to any increases in the top size and type of product being sampled, that is raw coal or washed coal.

The basic design of samples is dependent on the following preliminary information:

- a. Weight per cubic foot of material being sampled.
- b. Size of material and ash content of material being sampled.
- c. Moisture content (surface) of material sampled.
- d. Tons per hour in coal stream being sampled plus depth of stream and velocity of material to be sampled, if available.
- e. Width of chute where sample is to be installed.
- f. Quantity of sample desired for analysis, i.e., does primary sample need to be crushed and sampled by secondary sampler for smaller amount to be sent to laboratory.
- g. Lot size desired (the quantity of coal to be represented by the gross sample).

Sampling is broken up into two areas: primary and secondary. The primary sample is taken from the main flowing stream of coal. The secondary sample is taken from the primary sample stream of coal.

Some of the different types of samples are the plate type, belt type and rotary drum type. The traveling plate samples are extra heavy duty units designed primarily for high tonnages and special applications and are practically unlimited in this respect. The belt type samplers are usually used on belts up to 24 inches in width. The rotary drum type is usually used as a secondary sampler to reduce the gross sample.

10.1 CONVEYING

The transportation of coal from the unloading point up to the steam plant is an essential part of the handling system. No one type of conveyor can handle every conveying problem. It is necessary to consider all the variables such as the type and size of material capacity required and distance to be traveled both horizontal and vertical. It is also important to consider the auxiliary equipment such as bearings, takeups, pulleys and sprockets when selecting a conveyor.

The types of conveyors include flight, belt, screw, apron and pan, elevators and feeders. Each type has its own particular characteristics for its application. Sometimes they overlap each other. Only after careful consideration is the optimum type selected for a specific application.

10.1 FLIGHT CONVEYOR

This conveyor consists of match standard chains which pass around head and foot sprockets with transverse flights which push the material along a trough. Flight conveyors will operate horizontally or inclined up to a 45 degree slope.

10.2 APRON AND PAN CONVEYORS

These conveyors consist of overlapped steal pans which are supported between two strands of chain which pass around head and foot sprockets. These conveyors can also be used as feeders. Dividers can be placed in each apron. It then can convey more than one type or size of material at a time.

10.3 BELT CONVEYOR

The belt conveyor is an endless belt used for transporting materials either horizontally or on an incline. The belt travels between pulleys discharging the material over the head pulley. Take-ups are used to adjust the tension on the belt. This type of conveyor is more widely used than any other types of conveyors.

Carrying idlers are used to provide rolling surface for the belt. The idlers are usually the three roll type with the two side rollers inclined at approximately 20 degrees. Idler spacing, roll diameter and the correct bearings are important factors in the belt operations. Return idlers which are straight idlers, are provided for a smooth surface for the return of the belt. Impact idlers, a special type carrying idler, are placed at the load point to protect the belt.

Capacity of belt conveyors depends on the width of the belt, degree of troughing, speed, slope, size and specific gravity of the material being conveyed and its angle of repose.

If the belt does not discharge over the head pulley, some other arrangement must be provided. This is usually done by trippers. Traveling trippers are usually used so that the material being conveyed can be discharged at any point.

10.4 SCREW CONVEYORS

This conveyor is often used as a feeder. It is possibly the oldest device for the moving of bulk material. It is simply a conveyor screw rotating in a trough. They are usually totally enclosed.

Screw conveyors can be operated either as inclined or vertical conveyors. Their efficiency is much greater when operating on the horizontal.

10.5 BUCKET ELEVATORS

A bucket elevator consists of an endless chain or belt to which buckets are attached. They are used for elevating materials on vertical or inclined path. The basic types are centrifuged discharge, positive discharge, continuous bucket, single strand and continuous bucket-double strand.

11.0 COAL HANDLING SUPPORT OPERATIONS AND EQUIPMENT

Several other operations are often required to support a successful coal handling process.

11.1 WEIGHING COAL

Since coal is a major cost item in plant operation, it is important to weigh coal when it is delivered, and again just before it is burned. The first measurement insures that only the energy received is paid for; the second provides for plant performances calculations. The amount of coal delivered can be weighed either at the unloading point or somewhere in the handling system. Coal flowing to individual boilers is measured during final handling.

The basic types of scales used for weighing coal as received are the truck, rail, combination truck/rail and conveyor belt units. Weight indicators for these devices include: (1) Dials, with or without an automatic printout; (2) Registering beams; and (3) Digital indication.

11.2 DUST COLLECTION

This is a dry process using air flow to move the dust particles to be collected, usually by bag filters. Depending on the type of burning system used in the boiler, the dust particles may be put back in the system to be burned.

11.3 DUST SUPPRESSION

Dust suppression systems involve the spraying of water (mixed with a surface active compound) in the dust area to minimize the possibility of dust escaping to the atmosphere. The water is sprayed in a fine mist form to maximize its efficiency. Dust suppression is used at the transfer points throughout the entire handling system. Anytime coal is transferred from one type of equipment to another, dust problems usually occur.

11.4 MAGNETIC DEVICES

Magnetic devices are used to remove any metal object that makes its way in the main coal stream. It is very important to remove any type of metal to insure a longer equipment life. One of the main metal objects found in coal are the teeth broken off of draglines.

11.4.1 MAGNET

One type of magnetic device is a suspended electromagnet. This magnet is usually put over the tail end of the first conveyor.

11.4.2 MAGNETIC SEPARATOR

The magnetic separator is suspended over a head pulley. This separator consists of a magnet with an endless belt surrounding it. The magnetic separator not only picks up the iron but also conveys it to a collection box.

11.5 EXPLOSION PROOF TYPE EQUIPMENT

There are two very important things to know about coal: (1) Coal can produce a methane gas; and (2) Dust particles in suspension can be ignited. These two items only become dangerous in confined areas and then only where a spark, flash, electric arc, etc., is found.

Any area that is capable of producing an explosion or fire is called a hazardous (classified) location. Locations are classified depending on the properties of the flammable vapors, liquids or gases, or combustible dusts or fibers which may be present and the likelihood that a flammable or combustible concentration or quantity is present. Refer to the National Electrical Code, Articles 500 through 503 for a detailed description of classified locations.

An explosion proof device is a device enclosed in a case that is capable of withstanding an explosion of a specified gas or vapor which may occur within it and of preventing the ignition of a specified gas or vapor surrounding the enclosure by sparks, flashes, or explosion of the gas or vapor within, and which operates at such an external temperature that a surrounding flammable atmosphere will not be ignited thereby.

Without any further explanation in this area, you can easily see that hazardous locations can change the design of equipment. For example, a crusher located in a hazardous area might have to have an explosion proof motor and controls, depending on the classification of the area.

All in all, hazardous locations can be in any area of coal handling and should always be respected.

12.0 COAL HANDLING SYSTEMS

A coal handling system can be simple or complex, depending on how the coal is received, how the plant is situated, and what is expected from the system in terms of capacity, flexibility, convenience, etc.

Let's take a look at a more complex system (see figure 1.0). This system starts by unloading a train car by a rotary car dump into a track hopper. Hopper belt feeders feed a conveyor then to another conveyor thru a belt scale. Onto a transfer hopper then to a stacker reclaimer. The coal can also be put out to an emergency pile. After the stacker, it is conveyed to a surge hopper to a crusher and then to another transfer hopper. From the hopper it is fed to the coal silos at the power plant.

Now let's take a simple system. Let's assume we have a plant located in a basement. The coal is received by truck. The truck dumps directly into a bin, from which a screw conveyor carries coal to the stoker (burner).

There is no such thing as a typical coal handling system. What might work for one situation or area, might not for another. Figure 2.0 is a chart that shows a breakdown of the overall coal handling operation in typical steps. While the flow arrows indicate a great number of combinations, the chart cannot possibly cover all of the many possible arrangements.

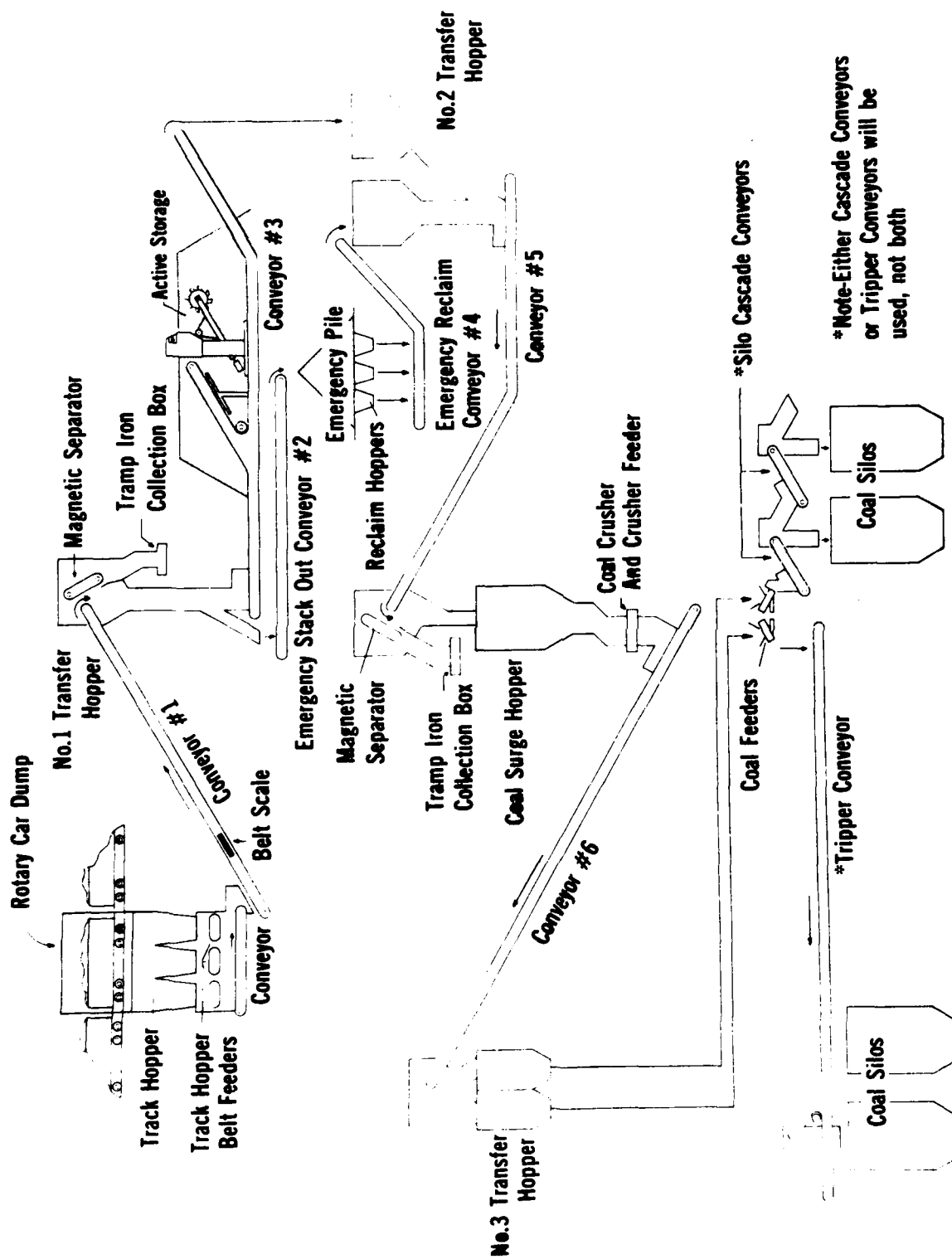
Let's go back to the complex system discussed previously. On the chart, the sequence might be 1A, 2, 4, 5, 3, 4, 6, 7, 8, 9.

The simple system with the truck unload would be 1C, 6, 7, 9.

13.0 CONCLUSIONS

The following general observations and remarks are made concerning this report.

- a. The size of the handling system will vary depending on the needs.
- b. Handling systems can be simple or complex.
- c. To assure proper design, outside engineering firms proficient in the coal handling area should be consulted.



*Note-Either Cascade Conveyors or Tripper Conveyors will be used, not both

Figure 1.0 Example of Coal Handling System Used At Large Power Plants

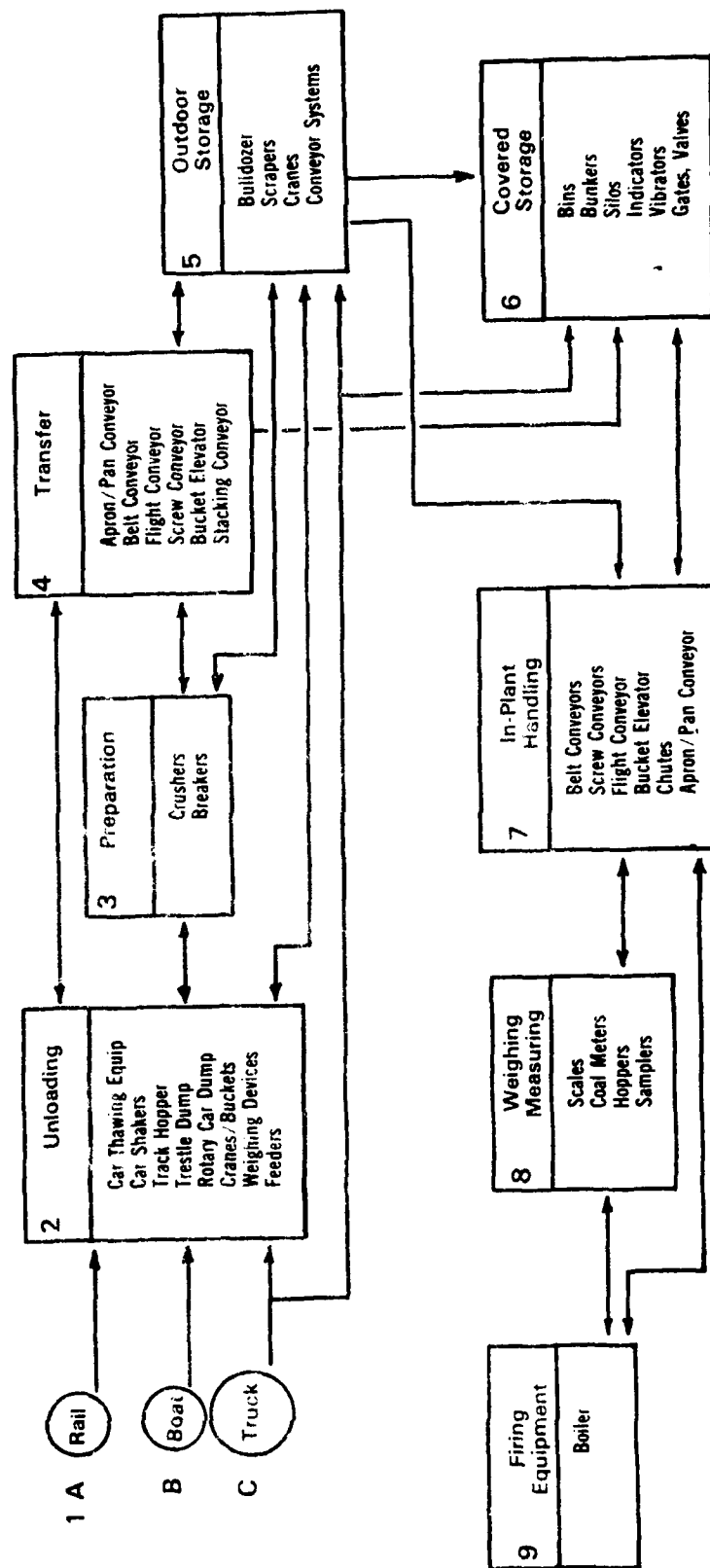


FIGURE 2.0

- d. A coal analysis should be performed by a professional fuel consultant.
- e. Emphasis should be put on the prevention of the possible dangers of explosions and fires.
- f. Efficient coal handling and proper equipment selection can reduce fuel costs.

14.0 GLOSSARY

- ANTHRACITE COAL - Any coal containing 86 to 98 percent fixed carbon, on a dry, mineral-matter-free basis.
- ASH - Theoretically, the inorganic salts contained in coal; practically, the residue from the combustion of dried coal that has been burned at 1,380°F.
- BITUMINOUS COAL - A broad class of coals containing 46 to 86 percent fixed carbon and 20 to 40 percent volatile matter.
- COAL - A natural solid material consisting of amorphous elemental carbon with various amounts of organic and inorganic compounds.
- DEAD STORAGE - A coal storage which is used to guard against delays in shipment.
- DEMURRAGE - Detention of a vessel, as in loading or unloading, beyond the time agreed upon.
- HARDGROVE GRINDABILITY - An index used to determine the resistance of coal pulverization.
- LIGNITE - A low rank of coal between peat and subbituminous.
- LIVE STORAGE - A storage of coal used to supply firing equipment direct.
- RAW COAL - Coal that has not been cleaned of any impurities.
- RUN-OF-MINE COAL - Coal as it is taken directly from the mine.
- SCREENS - Equipment used in sizing coal.
- SIZING - The grouping of coal particles into desired ranges of particle sizes.
- STOKER - A mechanical device for supplying coal or other solid fuels to a furnace.
- SUBBITUMINOUS COAL - A rank of coal between bituminous and lignite, classified by ASTM as having a range of heating values between 8,300 and 11,000 BTU per pound on a moist mineral-matter-free basis.
- WASHED COAL - Coal that has been through a cleaning process to remove any undesirable matter.
- WEATHERING - The combination of coal with oxygen and air.

15.0 REFERENCES

- a. L.A. Midkiff, "Designing for Coal-Handling Flexibility," Power, CXXIII (November 1979), S16-21.
- b. "Flexible System Design Should be Your Primary Goal," Power, CXVIII (February 1974), S11-24.
- c. McNally, Coal Preparation Manual, 1976.

16. MANUFACTURERS OF EQUIPMENT

16.1 Rotary Car (Railroad) Dumpers

- 16.1.1 Heyl Patterson, Inc.
- 16.1.2 FMC Corp, Materials Handling System Division
- 16.1.3 Dravo Wellman Co.

16.2 Apron Feeders

- 16.2.1 Hewitt-Robins Div. Litton Systems, Inc.
- 16.2.2 Universal Engineering Corp.
- 16.2.3 Dresser Industries, Inc.

16.3 Belt Feeder

- 16.3.1 Jervis B. Webb Co.
- 16.3.2 Fairfield Engineering Co.
- 16.3.3 Midwest Conveyor Co.

16.4 Vibrating Feeder

- 16.4.1 General Kinematics Corp.
- 16.4.2 FMC Corp Material Handling Equip. Div.
- 16.4.3 Webb, Jervis B.

16.5 Reciprocating Feeder

- 16.5.1 McNally Pittsburg Mfg. Corp.
- 16.5.2 Kennedy Van Saun Corp.
- 16.5.3 Fairfield Engineering Co.

16.6 Screw Feeder

- 16.6.1 Dresser Industries, Inc.
- 16.6.2 Lively Mfg. & Equipment, Inc.
- 16.6.3 Barber-Green Co.

16.7 Stack Reclaimer

- 16.7.1 McNally Pittsburg Mfg. Corp.
- 16.7.2 Stephens - Adamson, Inc.
- 16.7.3 Heyl & Patterson, Inc.

16.8 Telescopic Chutes

- 16.8.1 Midwest Conveyor Co.
- 16.8.2 McNally Pittsburg Mfg. Corp.
- 16.8.3 Webb, Jervis B.

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16.9 Roll Crushers

- 16.9.1 McNally Pittsburg Mfg. Corp.
- 16.9.2 Schroeder Bros. Corp.
- 16.9.3 Pennsylvania Crusher Corp.

16.10 Hammer Crusher

- 16.10.1 American Pulverizer Co.
- 16.10.2 Jeffery Mfg. Div, Dresser Industries, Inc.
- 16.10.3 Kennedy Van Saun Corp.

16.11 Ring Crusher

- 16.11.1 American Pulverizer Co.
- 16.11.2 Pennsylvania Crusher Corp.
- 16.11.3 Universal Engineering Corp.

16.12 Rotary Breaker

- 16.12.1 Heyl & Patterson
- 16.12.2 Kennedy Van Saun Corp.
- 16.12.3 McNally Pittsburg Mfg. Corp.

16.13 Samplers

- 16.13.1 McNally Pittsburg Mfg. Corp.
- 16.13.2 Lively Mfg. & Equip. Co.
- 16.13.3 Kennedy Van Corp.

16.14 Flight Conveyor

- 16.14.1 Dresser Industries, Inc.
- 16.14.2 Webb, Jervis B. Co.
- 16.14.3 Fairfield Engineering Co.

16.15 Apron Conveyor

- 16.15.1 FMC Corp., Materials Handling Systems Div.
- 16.15.2 McNally Pittsburg Mfg. Corp.
- 16.15.3 Webb, Jervis B. Co.

16.16 Belt Conveyor

- 16.16.1 McNally Pittsburg Mfg. Corp.
- 16.16.2 Webb, Jervis B. Co.
- 16.16.3 Midwest Conveyor Co.

16. MANUFACTURERS OF EQUIPMENT (Continued)

16.17 Screw Conveyor

- 16.17.1 Webb, Jervis B. Co.
- 16.17.2 McNally Pittsburg Mfg. Corp.
- 16.17.3 FMC Corp., Material Handling Equipment Div.

16.18 Bucket Elevator

- 16.18.1 Fairfield Engineering Co.
- 16.18.2 Webb, Jervis B. Co.
- 16.18.3 Dresser Industries, Inc.

16.19 Weighing Devices

- 16.19.1 Merrick Scale
- 16.19.2 Ramsey Engineering Co.
- 16.19.3 Kay-Ray, Inc.

16.20 Dust Collectors

- 16.20.1 American Air Filter Co., Inc.
- 16.20.2 Research-Cottrell, Inc.
- 16.20.3 General Resource Corp.

16.21 Dust Suppression

- 16.21.1 Fairfield Engineering Co.
- 16.21.2 Aquadyne, Div. of Motomco, Inc.
- 16.21.3 General Resource Corp.

16.22 Magnetic Devices

- 16.22.1 Dings Co., Magnetic Group
- 16.22.2 Eriez Magnetics
- 16.22.3 Stearns Magnetics Inc., Div. of Magnetics, Intl.

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Barber-Greene Co.
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Dings Co., Magnetic Group
4742 W. Electric Ave
Milwaukee, WI 53219

Dravo Wellman Co.
113 St. Clair Ave. N.E.
Cleveland, OH 44114

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Dallas, TX 75201

Eriez Magnetics
381 Magnet Dr
Erie, PA 16512

Fairfield Engineering Co.
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Marion, OH 43302

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Kansas City, KS 44711

Pennsylvania Crusher Corp
P.O. Box 100
Broomau, PA 19008

Ramsey Engineering Co.
1853 W. County Rd. C.
St Paul, MN 55113

Research-Cottrell, Inc
P.O. Box 1500
Somerville, NJ 08876

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Fort Monmouth, NJ 07703

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Jefferson Proving Ground
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Dugway Proving Ground
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USA Engr Dist, Omaha
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USA Engr Dist, Fort Worth
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USA Engr Dist, Sacramento
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USA Engr Dist, Far East
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USA Engr Div, Ohio River
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